Case Study: The analysis of irrigation pump efficiency on farms

By Koos Bouwer

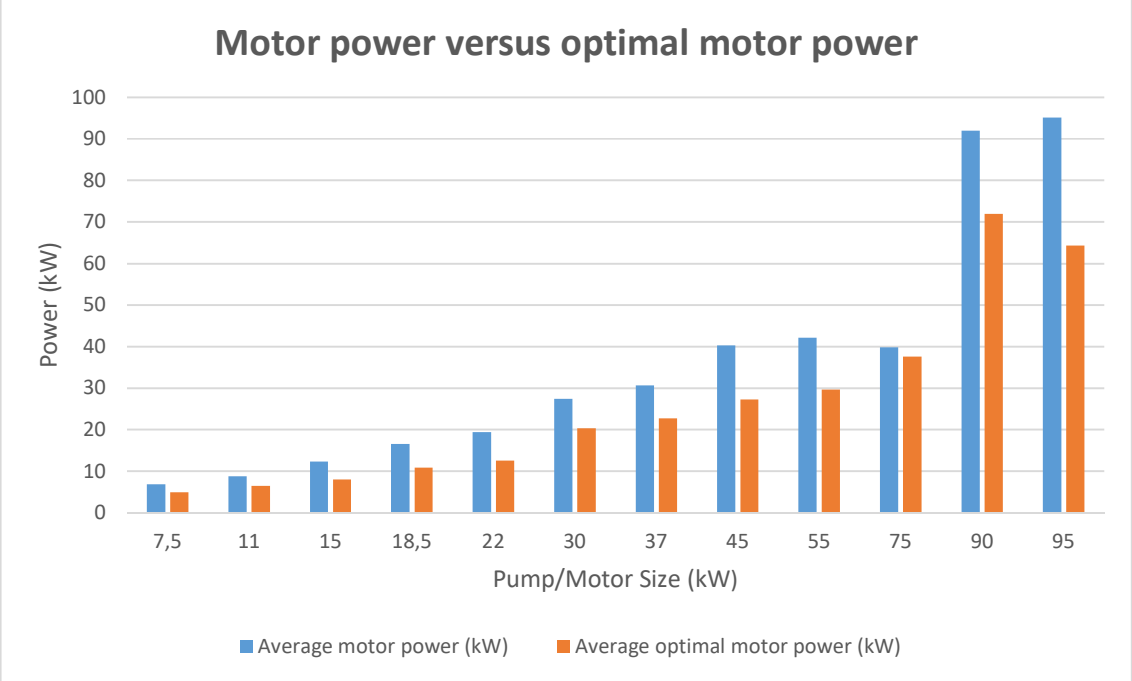
Previous CCC carbon footprint reports have shown that irrigation pumps are the largest electricity user on farms. In recent years many farms had the opportunity to participate in energy efficiency studies that were done as part of the IEE and PSEE projects. This case study summarizes the results of the analysis of the energy efficiency of 140 pumps that were tested as part of these projects.

The energy efficiency of an irrigation pumping system is influenced by two conditions:

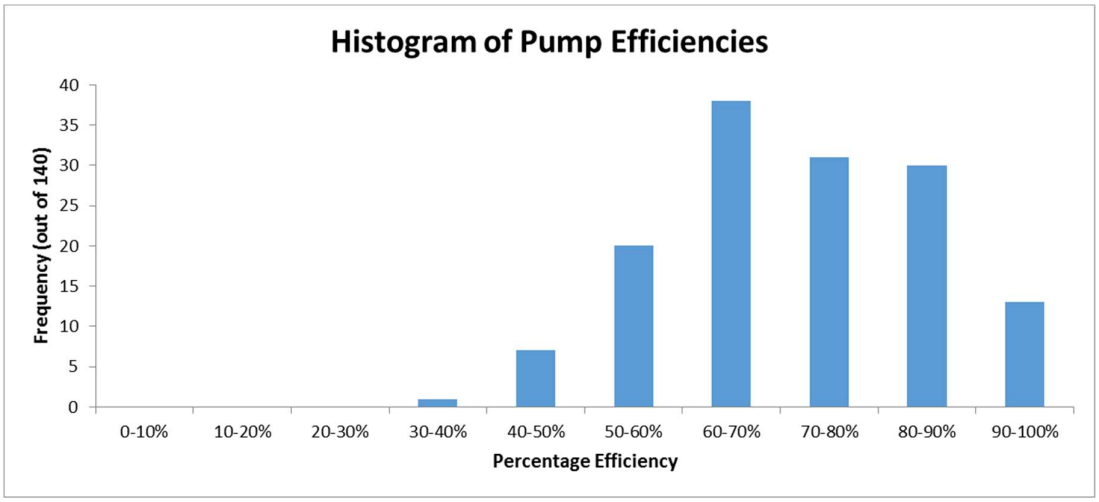
- The ability of the pump to transform electrical energy to fluid energy (pressure and flow)
- The design of the rest of the irrigation system (pump size, motor size, pipe sizes, nozzles, sprinklers, drippers, etc.) that determines the pressure and flow requirements.

In this analysis, the design of the irrigation system were accepted as a given, and the focus was only on the ability of the pump and motor combination to transform the electrical energy into fluid energy. Input measurements were taken as the electrical power consumption of the motor, the water flow rate and the pressure difference between the intake and outlet of the pump.

The average rated pump/motor size in this analysis of 140 pumps was 32kW, with a distribution of sizes between 7.5kW and 95kW. The results are shown in the graph below.



The optimum power is obtained from a PSAT computer program which is in line with the relevant manufacturer pump curve information. The information shows that the actual power consumed was more than the optimum power for that pump. On average the pumps consume 39% more power than what is considered optimal. This means that a 28% saving from current values is possible. The next graph shows a histogram of the pump efficiencies for the same sample of 140 pumps.



The information shows that there were 8 pumps with efficiencies less than 50% and 13 pumps with efficiencies more than 90%. The rest of the 140 pumps have efficiencies between 50% and 90%. An efficiency of 50% means that the pump use twice as much electricity as it should.

The reason for the lack of efficiency is located in the pump and motor combination, and is most likely due to wear and tear of pump components. Please note that pipe sizes and installation of VSD's have no effect on these values because it was only the pump efficiency that was measured during this analysis, and not the total pumping system efficiency. The installation of a VSD will only reduce flow rate and pressure but the pump efficiency will stay the same regardless of pump speed.

In conclusion: A sample of 140 irrigation pumps has shown an average energy saving potential of 28% which can be linked to the condition of the pumps. This also equates to a potential carbon footprint reduction of 28% and an electricity cost reduction of 28%.

Koos Bouwer

0828878425

koos@kbcindustrial.co.za